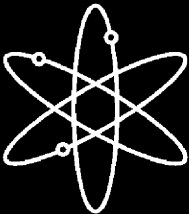




Licensed Fuel Facility Status Report



Inventory Difference Data
July 1, 2001 - June 30, 2002



**U.S. Nuclear Regulatory Commission
Office of Nuclear Security and Incident Response
Washington, DC 20555-0001**



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Manuscript Completed: September 2003
Date Published: October 2003

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Washington, DC 20555-0001



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ABSTRACT

The U.S. Nuclear Regulatory Commission is committed to an annual publication of licensed fuel cycle facility inventory difference data, following Agency review of the information and completion of any related investigations. Information in this report includes inventory difference results for active fuel fabrication facilities possessing more than one effective kilogram of special nuclear material.

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ABBREVIATIONS/ACRONYMS

AI	Active inventory
BI	Beginning inventory
C.L.	Confidence level
CFR	Code of Federal Regulations
DQ	Detection quantity
DT	Detection threshold
EI	Ending inventory
FKG	Formula kilogram(s)
HEU	High-enriched uranium
ID	Inventory difference
LEU	Low-enriched uranium
MUF	Material unaccounted for
NRC	Nuclear Regulatory Commission
Pu	Plutonium
SEID	Standard error of an inventory difference
SM	Source material
SNM	Special nuclear material
SSNM	Strategic special nuclear material
U-233	Uranium-233
U-235	Uranium-235
Pu-238	Plutonium-238
Pu-239	Plutonium-239
Pu-241	Plutonium-241

**LICENSED FUEL FACILITY STATUS REPORT
ANNUAL REPORT OF INVENTORY DIFFERENCE DATA
NUREG-0430, VOLUME 22**

1. INTRODUCTION

The Licensed Fuel Facility Status Report (NUREG-0430) is a periodic report that provides inventory information on NRC-licensed fuel cycle facilities. The information included in NUREG-0430 consists of a tabulation of inventory difference data for all active fuel cycle facilities, a list of acronyms, and a glossary of various term definitions used throughout this publication. The first semiannual issue of NUREG-0430 was published on May 16, 1978. With the second issue of Volume 9 published in April 1990, the NRC changed to a one-year interval because most of the licensed fuel cycle facilities were on an annual inventory frequency.

All fuel cycle facilities authorized to possess and use more than one effective kilogram of special nuclear material (SNM) are required to report the results of each physical inventory to the NRC pursuant to 10 CFR 74.17. This report contains a tabulation of physical inventory results generated during the one-year period from July 1, 2001, to June 30, 2002, for the seven active fuel fabrication facilities and two active uranium enrichment facilities (gaseous diffusion plants).

2. DISCUSSION

The NRC uses a graded approach in applying safeguards requirements for all licensed facilities, depending on the strategic significance of the SNM authorized for possession, and the level and frequency of monitoring programs required for timely detection of losses. It is important to distinguish between the low strategic significance of low-enriched uranium (LEU) and the higher strategic significance of high-enriched uranium (HEU) and plutonium. LEU materials used to fabricate fuel assemblies for commercial power reactors are enriched to a level of one to 5 percent in the U-235 isotope. At this enrichment level, and under certain conditions, the uranium can sustain a chain reaction, but cannot generate a nuclear explosion regardless of its quantity and configuration.

NRC safeguards requirements covering LEU reflect its low strategic significance. They include a formal structured system for material control and accounting and graded physical protection measures. Because of the higher strategic significance of HEU and plutonium, which under certain circumstances could be used for the fabrication of a nuclear explosive device, the NRC requires HEU licensees to provide substantial physical protection of these materials including features such as barriers, intrusion alarms, armed guards, and offsite police response capability. Additionally, more rigorous controls and accounting programs are imposed, including internal systems to control the movement of strategic SNM and to monitor its presence.

Licensees authorized to have significant quantities of strategic SNM (i.e., HEU, plutonium, or uranium-233) are required to conduct physical inventories at least every six months, and facilities authorized to possess and use more than one effective kilogram of SNM of moderate strategic significance are required to conduct physical inventories at least every nine months, whereas licensees whose holdings are restricted to SNM of low strategic significance perform physical inventories every twelve months.

At each physical inventory, the quantity of SNM on hand, as physically determined, is compared to the quantity of SNM on hand as indicated by the facility's accounting records (or book inventory). The difference between the physical inventory and the book inventory is called *Inventory Difference* (ID), also sometimes referred to as material unaccounted for (MUF).

ID values resulting from physical inventories conducted at facilities authorized to possess and use significant quantities of strategic SNM are classified as "CONFIDENTIAL National Security Information" until at least six months have elapsed since the ID was derived, and any excessive ID has been investigated and resolved. For this reason, the ID data are not published until the six months have elapsed.

Non-zero IDs, both positive and negative, result from a combination of factors such as measurement variability, measurement mistakes, changes in the quantity of unmeasured equipment holdup, and record keeping errors. An unmeasured loss, either accidental or deliberate, or theft would cause an unidirectional impact on determining ID (e.g., mathematically increase a positive ID or decrease a negative ID). Generally, the more complex a facility's process operations are, especially when dealing with chemical operations, the greater the potential for uncertainty associated with an ID value. Although an ID larger than its overall measurement uncertainty may signal an abnormal situation, the fact that an ID falls within its associated limit of error, even a zero ID value, provides no automatic or conclusive proof that a loss or theft of SNM has not occurred. Therefore, the NRC relies on information provided not only by the material accounting system, but also by the internal control system, the physical protection system, NRC inspections and evaluations, plus NRC and licensee investigations.

Both the book inventory and the physical inventory are based on measured values. Thus, both are subject to measurement uncertainty. The total uncertainty associated with an ID value is designated by the *standard error of the inventory difference* (SEID), which is a 67 percent confidence level uncertainty. Therefore, in the absence of recording errors, unmeasured losses, and material theft or diversion, the expected value of an ID is zero plus or minus SEID, depending on the desired confidence level.

Active inventory is the quantity of material measured for accountability purposes since the last physical inventory, and for throughput-dominated facilities is essentially equal to twice the throughput for the inventory period. The concept of SEID is a method that the NRC and licensees subject to either 10 CFR 74.31, 74.33, 74.43, or 74.59 use to determine the significance of the ID. For 10 CFR 74.31 and 74.33 licensees (Category III facilities), ID must exceed its threshold quantity, which represents a site-specific value that is considerably larger than SEID, before investigative actions are required. For 10 CFR 74.43 licensees (Category II facilities) and 74.59 licensees (Category I facilities), investigative actions are required whenever an ID exceeds both specific quantities and three times SEID. In addition, an ID that exceeds its associated SEID may be an indication of processing problems, inaccurate measurements, bookkeeping errors, or a loss or theft of material. The NRC accordingly requires the licensees to take increasingly stronger investigative actions depending on how much the ID exceeds both SEID limits and specific quantities.

3. CONCLUSION

The IDs for this reporting period (July 1, 2001, through June 30, 2002) are listed in the "Tabulation of Inventory Differences" that begins on page 8 of this report. An explanation of the significance and, when appropriate, the contributing factor(s) for IDs deemed excessive are included in the last column of the table. A total of 15 ID values was generated during this reporting period; 6 pertained to HEU, and 9 pertained to LEU materials. All of the IDs were either within regulatory limits or expected ranges except three IDs exceeded its regulatory limits. The excessive IDs were either ID gains or losses resulting from measurement biases of heterogeneous scrap materials. These IDs were investigated by the licensee and no anomalous condition was identified. No enforcement or regulatory action was required.

4. DEFINITION OF TERMS

1. Active Inventory (AI): The sum of beginning inventory (BI), additions to inventory (A), removals from inventory (R), and ending inventory (EI), after all common terms have been totally excluded. A common term is any nuclear material value (or item) that appears in both BI and EI, or both BI and R, or both A and R, or both A and EI, with both values derived from the same measurement (or combination of measurements), and thus does not contribute to the uncertainty associated with the current period inventory difference. The active inventory is used as an indicator of processing throughput and/or measurement activity.
2. Depleted Uranium: Any uranium-bearing material whose combined U-233 plus U-235 isotopic content is less than 0.70 percent by weight (relative to total uranium element content).
3. Detection Quantity (DQ): A site-specific SNM quantity for Category III licensees whose processing activities are limited to SNM of low strategic significance. The DQ is normally a function of an annual throughput, but for low-throughput LEU facilities, the DQ need not be less than 25 kilograms of U-235. The DQ can also be described as a goal quantity, the loss or theft of which must be detected with a 90 percent or better probability, whenever a physical inventory is taken.
4. Detection Threshold (DT): An ID alarm limit for Category III licensees that will be exceeded (with 90 percent or higher probability) by an ID (resulting from the taking of a physical inventory) whenever there has been an actual loss of a detection quantity. The DT is a function of both the DQ and SEID, as shown in the following equation:
$$DT = DQ - 1.3 (SEID)$$
5. Effective Kilogram of SNM: (1) For plutonium and U-233, their weight in kilograms; (2) for uranium with an enrichment in the isotope U-235 of 1.00 percent (0.01 weight fraction) and above, its element weight in kilograms multiplied by the square of its enrichment expressed as a decimal weight fraction; and (3) for uranium with an enrichment in U-235 below 1.00 percent, but above 0.71 percent, its element weight in kilograms multiplied by .0001.
6. Fissile Isotope: A nuclide species that is capable of giving rise to a self-sustaining chain reaction (of a nuclear fission) when present in sufficient mass and concentration. U-233, U-235, Pu-239, and Pu-241 are the only fissile nuclides contained in "special nuclear material" (SNM), which also consists of other uranium and plutonium isotopes.
7. Formula Kilogram (FKG): 1,000 formula grams of SSNM computed by the following equation:

$$\begin{aligned} \text{Grams} = & (\text{grams U-235 contained in HEU}) + 2.5 (\text{grams U-233}) \\ & + 2.5 (\text{grams plutonium}) \end{aligned}$$

8. Formula Quantity: SSNM in any combination in a quantity of 5,000 formula grams or more, as computed by the same equation as given above in definition No. 11.

NOTE: In unirradiated form, this quantity of SSNM is sometimes referred to as a Category I quantity of material.

9. High-Enriched Uranium (HEU): Any uranium-bearing material whose uranium isotope content is 20 percent or more U-235 by weight (relative to total uranium element content).
10. Inventory Difference (ID): The arithmetic difference between a book inventory and the corresponding physical inventory, calculated by subtracting ending inventory (EI) from the combination of beginning inventory (BI) plus additions to inventory (A) minus removals from inventory (R). Mathematically, this can be expressed as:

$$ID = (BI + A - R) - EI \quad \text{or} \quad ID = BI + A - R - EI$$

11. Isotope: A nuclide of a chemical element (such as uranium or plutonium) whose atoms all have the same number of protons characteristic of that element combined with different numbers of neutrons. That is, all isotopes of a given element must have the same number of protons within the nuclei of their atoms, but the number of neutrons per nucleus varies between isotopes. It is the number of protons plus neutrons within an atom's nucleus that defines its mass number. For example, U-235 and U-238 are two isotopes of uranium. Both contain 92 protons but have 143 and 146 neutrons, respectively, within the nucleus of each of their atoms.
12. Low-Enriched Uranium (LEU): Any uranium-bearing material whose uranium isotope content is less than 20 percent, but greater than 0.71 percent, U-235 by weight (relative to total uranium element content).
13. Natural Uranium: Any uranium-bearing material whose uranium isotopic distribution has not been altered from its naturally occurring state. Natural uranium is nominally 99.283 percent U-238, 0.711 percent U-235, and 0.006 percent U-234.
14. Negative ID: A situation that occurs when the amount of SNM on hand, as determined by the physical inventory, exceeds the amount of SNM being carried on the books (records). That is, there appears to be a gain in material. Mathematically, a negative ID is written as "-ID," or shown in parentheses. A negative ID is also referred to as an "ID gain."
15. Plant: For SNM control and accounting purposes, a plant is defined as a set of processes or operations (on the same site, but not necessarily all in the same building) coordinated into a single manufacturing, R&D, or testing effort. Most licensees have only one plant in this context. A scrap recovery operation serving both onsite and offsite customers, or more than one onsite manufacturing effort (plant), would be treated as a separate plant.
16. Positive ID: A situation that occurs when the amount of SNM on hand, as determined by the physical inventory, is less than the amount of SNM being carried on the books (records). That is, there appears to be a loss of material. Mathematically, a positive ID is written as "+ID," or is shown without any designation of a sign. A positive ID is also referred to as an "ID loss."

17. Source Material (SM): (1) Natural uranium or thorium, or depleted uranium, or any combination thereof, in any physical or chemical form, or (2) ores that contain by weight 0.05 percent or more of (i) uranium, (ii) thorium, or (iii) any combination thereof. SM does not include SNM.
18. Special Nuclear Material (SNM): (1) Plutonium, uranium-233, uranium enriched in the isotope uranium-235, and any other material that the U.S. Government, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, determines to be SNM; or (2) any material artificially enriched in any of the foregoing. SNM (of any type) does not include SM.
19. SNM Material Type Categories: For inventory and accounting purposes, SNM is classified into six material type categories (not to be confused with Categories I, II, and III quantities). The six categories are uranium in cascades, LEU, HEU, uranium-233, plutonium, and plutonium-238. For each category, SNM is accounted for on both a total element and isotope basis. The element and isotope for each category are as follows:

<u>CATEGORY</u>	<u>ELEMENT</u>	<u>ISOTOPE</u>
Uranium in Cascades	Total Uranium	U-235
LEU	Total Uranium	U-235
HEU	Total Uranium	U-235
Uranium-233	Total Uranium	U-233
Plutonium	Total Plutonium	Pu-239 + Pu-241
Plutonium-238	Total Plutonium	Pu-238

20. SNM of Low Strategic Significance: (1) Less than an amount of SNM of moderate strategic significance, but more than 15 grams of (i) U-235 contained in HEU, (ii) U-233, (iii) plutonium, or (iv) any combination thereof; (2) less than 10,000 grams, but more than 1,000 grams of U-235 contained in LEU enriched to 10 percent or more (but less than 20 percent) in the U-235 isotope; or (3) 10,000 grams or more of U-235 contained in LEU enriched above natural, but less than 10 percent, in the U-235 isotope.

NOTE: In unirradiated form, any of the above three quantities are sometimes referred to as a Category III quantity.

21. SNM of Moderate Strategic Significance: (1) Less than a formula quantity of SSNM, but more than 1,000 grams of U-235 contained in HEU, or more than 500 grams of U-233 or plutonium, or more than a combined quantity of 1,000 formula grams when computed by the equation:

$$\text{Formula Grams} = (\text{grams U-235 in HEU}) + 2.0 (\text{grams U-233} + \text{grams Pu})$$

or (2) 10,000 grams or more of U-235 contained in LEU enriched to 10 percent or more (but less than 20 percent) in the U-235 isotope.

NOTE: In unirradiated form, either of the aforementioned two quantities is sometimes referred to as a Category II quantity.

22. Standard Error of the ID (SEID):
- (a) For Category III licensees subject to 10 CFR 74.31 or 74.33, SEID is equal to the square root of the sum of both measurement and non-measurement variances associated with an ID.
 - (b) For Category I and II licensees subject to 10 CFR 74.59 and 74.43, respectively, SEID is equal to the square root of the measurement variance (only) associated with an ID.
23. Strategic Special Nuclear Material (SSNM): Uranium-235 contained in HEU, uranium-233, or plutonium.
- NOTE: All SSNM is SNM, but not all SNM is SSNM.
24. The ID Exceeded Its Regulatory Limit: The ID exceeded its applicable regulatory limit and was thus subject to both licensee and NRC investigations to determine the cause(s) of the excessive value (regardless of whether the ID was negative or positive).
25. The ID Was Within Its Expected Range: The ID was less than (i) 200 grams plutonium or U-233, (ii) 300 grams U-235 contained in HEU, or (iii) 9,000 grams U-235 contained in LEU, as appropriate.
26. The ID Was Within Its Regulatory Limit: The ID exceeded both (1) 200 grams U-233 or plutonium, 300 grams U-235 contained in HEU, or 9,000 grams U-235 contained in LEU (as appropriate), and (2) its associated SEID, but was less than the ID limit. For 10 CFR 74.31 and 74.33 licensees, the ID limit is the site-specific detection threshold quantity, which is considerably larger than SEID. For 10 CFR 74.43 and 74.59 licensees, the ID limit is 3 times SEID.

5. TABULATION OF INVENTORY DIFFERENCES

Licensee	SNM License No.	Docket No.	SNM Category	Inventory Date	Inventory Difference (Grams U-235)	Explanation [See definitions #24, 25, & 26]
BWX Technologies, Inc. (formerly Babcock & Wilcox) Nuclear Products Division Lynchburg, Virginia	42	70-27	HEU	10/31/01	+ 864	The ID was within its regulatory limit.
			HEU	03/31/02	+ 206	The ID was within its expected range.
			LEU	03/31/02	+ 1,339	The ID was within its expected range.
Nuclear Fuel Services Erwin, Tennessee	124	70-143	HEU	08/09/01	+ 5	The ID was within its expected range.
			HEU	02/01/02	+ 2,664	The ID exceeded its regulatory limit of 3 times SEID. The ID loss resulted from measurement biases. No enforcement or regulatory action was required.
			HEU	05/17/02	+ 3, 913	The ID exceeded its regulatory limit of 3 times SEID. The ID loss resulted from measurement biases. No enforcement or regulatory action was required.
			LEU	06/26/02	- 38,460	The ID exceeded its regulatory limit. The ID gain resulted from decommissioning activities. No regulatory action was required.

5. TABULATION OF INVENTORY DIFFERENCES (CONTINUED)

Licensee	SNM License No.	Docket No.	SNM Category	Inventory Date	Inventory Difference (Grams U-235)	Explanation [See definitions #24, 25, & 26]
Framatome ANP (formerly Framatome-Cogema Fuels) Lynchburg, Virginia	1168	70-1201	LEU	03/19/02	- 2,603	The ID was within its expected range.
Framatome ANP (formerly Siemens Nuclear Power Corp.) Richland, Washington	1227	70-1257	LEU	02/22/02	+ 21,074	The ID was within its regulatory limit.
Global Nuclear Fuel, Americas (formerly General Electric Company) Wilmington, North Carolina	1097	70-1113	LEU	07/12/01	- 4,225	The ID was within its expected range.
U. S. Enrichment Corp. Paducah Gaseous Diffusion Plant Paducah, Kentucky	GDP-1	70-7001	LEU	09/30/01	+ 79,979	The ID was within its regulatory limit.

5. TABULATION OF INVENTORY DIFFERENCES (CONTINUED)

Licensee	SNM License No.	Docket No.	SNM Category	Inventory Date	Inventory Difference (Grams U-235)	Explanation [See definitions #24, 25, & 26]
U. S. Enrichment Corp. Portsmouth Gaseous Diffusion Plant Piketon, Ohio	GDP-2	70-7002	HEU	09/30/01	+ 31	The ID was within its expected range.
			LEU	09/30/01	- 83,671	The ID was within its regulatory limit.
Westinghouse Electric Corp. Columbia, South Carolina	1107	70-1151	LEU	04/27/02	+ 2,015	The ID was within its expected range.
Westinghouse Electric Corp. (formerly Combustion Engineering) Hematite, Missouri	33	70-36	LEU	06/30/02	- 73,603	The ID was within its regulatory limit.

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OCTOBER 2003